Ogden Trust Summer Internship 2019

University of Birmingham

School of Physics and Astronomy

Reflective Diary

Aaron Vitarana

Host Supervisor:
Prof. Kostas Nikolopoulos

Preface

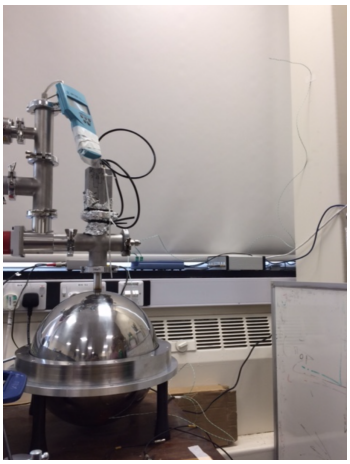
This Summer, I completed a research internship at the University of Birmingham (UoB). Through this reflective diary, I aim to present a concise and coherent account of my six weeks under the supervision of the Birmingham Particle Physics Group. For this reason, I have been greatly selective in describing only the events that were most critical to my learning experience and these events are not necessarily chronologically ordered. One of the key insights I gained during my time at UoB was a greater appreciation of the non-linear nature of the scientific research process. Although you may begin with certain initial ideas for your research, you must be willing to adapt to explore different directions when interesting results arise; developing an intuition on how to navigate the winding path of academia is crucial for success.

To give some educational background, at the start of my internship, I had just completed the first year of my Physics undergraduate degree. Having previously studied Maths, Further Maths, Physics and Chemistry at A Level, I had a general appreciation of the natural sciences, but, due to the intense focus of research, the utility of this prior knowledge was limited. However, intrigued by Particle Physics at A Level, I had also undertaken a relevant EPQ on dark matter direct detection methods. I kept this in mind when applying for internships; I wanted to pursue my interest further and hoped I would enjoy a more practical project.

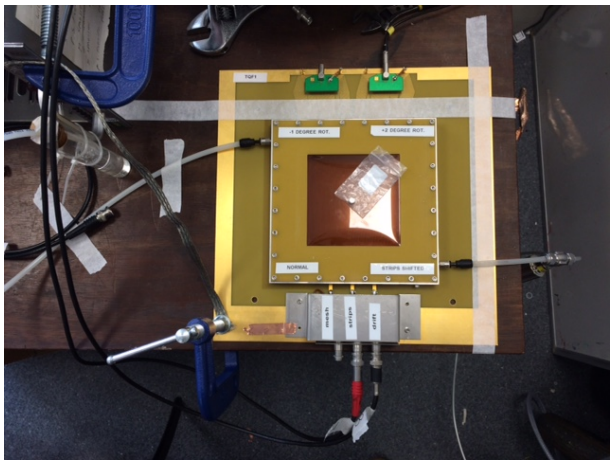
I was excited to work on a longer project and broaden my experience of Physics beyond the standard degree course, since I felt compulsory degree laboratory work is not an accurate representation of actual research. From the internship, I wanted to gain a better sense of direction for what I want to do as a postgraduate. Having applied for an internship entitled, "Simulation Study of Novel Gaseous Detector for Dark Matter Searches", I expected that my role in the project would be entirely computing-based. In reality, I found that I was also required to complete physical tasks, such as soldering, to advance the project. My main fear regarding the internship was that I would be doing mundane non-important tasks that offered no meaningful contribution. However, my supervisors made it clear from the start that everything I was going to do would have a direct impact on the project.

Internship
(08/07/2019 - 16/08/2019)

Upon arrival at UoB, I was taken to the experimental laboratory, which contained the two detectors I worked with- the spherical detector (informally known as 'the sphere') and the MICROMEGAS. I was introduced to the other members of the group, including other interns. I worked closely with another Ogden Trust intern in particular and we got along well. I enjoyed the balance of working individually the majority of the time when coding, but working together when operating the particle detectors.



(a) Spherical Detector



(b) MICROMEGAS

Figure 1: Detectors

The average working day for me involved catching a bus to arrive at 09:00. We would proceed to work till around 12:30, then have lunch. Work ended at 17:00 or possibly later if there was something important to finish that day. However, I knew this was common place to ensure meticulous results are obtained and PhD students often work much longer hours, so I expected and welcomed this. The hours are pretty similar to the schedule I (aim to) use during term time and, when treated as a regular 9-5 job, I felt it was not difficult to adapt to. On the other hand, I was surprised by the lack of small breaks taken through the day. There seemed to be an attitude of working constantly, but I found taking smaller breaks consistently was more productive overall. No particular dress code was enforced, so the work was comfortable in smart casual clothing.

Each Friday at 11:00, there was a compulsory group meeting, where all the members of the group were required to discuss their findings. On a weekly basis, this meant I needed to prepare slides using LaTeX. Presenting was not very daunting and I feel I communicated what I did effectively. I thought the group expectation for everyone to understand all parts in the project

was an important practice. Although a lot of work initially, it gave everyone an overall picture of the project's development, heightened the significance of your individual work and facilitated switching between different sides of the project. However, it was not all work as we would usually finish slightly early on Friday evening and go to the student bar with the supervisors. I even learnt how to play bridge one week!

Reading was the main focus for the first couple of days to ensure a comprehensive understanding of the underlying principles; the reading gradually became more specialised from standard Particle Physics textbooks to papers on the specific detectors. Despite prior knowledge, I vastly developed my general understanding of particle detection. Having a postdoc and PhD student nearby to clarify questions was extremely useful, especially when learning technical jargon. For me, this mentoring style is very beneficial and it accelerated my learning process significantly.

Although I felt well-prepared conceptually, I was still initially apprehensive in using practical equipment. The sensitive and expensive equipment we were using could be rendered useless instantly if operated carelessly. I was pleasantly surprised by the level of responsibility given to us by the host organisation, as we took measurements without supervision in the second week.

For the first half of the internship, I worked mostly in the laboratory. I installed devices that improved the detector and wrote code to use in combination. C++ was a new programming language for me. There was a steep initial learning curve, but I picked up the syntax quickly and now feel confident in my ability.

Working in an actual laboratory, improved my awareness of good (and bad) practice within the lab. I was required to write activities carried out relating to the detectors in the log book, with date and time included. This practice seemed slightly pointless in single day laboratory work, but I gained a greater appreciation of the importance of keeping an accurate record of completed work that can be referred to at a later date. Also, writing clear README documents, to describe how to operate devices, and clearly commenting code are vital, since they help others significantly. I also learnt about difficulties of transferring code between computers when paths are hard-coded.

During later weeks, I moved to the computing lab. This meant more specialised reading and I even read a paper written by one of my supervisors! I spent most of my time modifying pre-existing code to create plots using data from a similar detector located in France. I saw how central collaboration is to modern physics research, not only limited to within a University, but internationally as well. Multiple of my supervisors also left to discuss research with the group in France; I worked with much less supervision in the last couple weeks.

There are definite advantages to working more independently, but, in hindsight, I would have preferred to spend a bit more time on this side of the project before having as much independence. At times, I did not know what to do exactly, but, having sent a minimum of 3 emails a day, I overcame problems and continued making steady progress.

Evaluation of Experience

The overall experience was a valuable insight into research Physics and I am still interested in pursuing Particle Physics research in the future. Spending most of my time coding in C++, I am much more confident in my coding ability. I think writing code to solve a practical problem is the most effective way to learn a programming language. Also, using cheat sheets to learn shortcuts can also make coding much more time-efficient.

For me, the most intense aspect of the internship was the requirement to switch between tasks quickly. However, I am grateful that this opportunity has enabled me to develop a wide skill-set, not only in computational Physics, but also in experimental Physics. Observing others, it is clear to me a top physicist should have a strong grasp of the experimental, computational and theoretical aspects of their research.

I would like to thank the Ogden Trust for this incredible opportunity. Also, I want to thank my supervisors- Prof. Kostas Nikolopoulos, Dr. Ioannis Katsioulis and PhD student Patrick Knights- who taught me a lot and ensured that I enjoyed my time at UoB.

Word Count: 1433